Patent Claims

1. A headlight having a multitude of headlight elements, which each have:

- at least one semiconductor chip which emits electromagnetic radiation and has a chip output surface through which electromagnetic radiation is emitted,
- a primary optics element, which has a light input and a light output and which reduces the divergence of the light which is incident through the light input, with the light being at least part of the electromagnetic radiation and/or at least part of a secondary radiation which is produced from the electromagnetic radiation, and
- at least one headlight element output, which emits a part of the headlight light from the headlight element,

characterized in that

at least some of the headlight element outputs are arranged in at least two groups in such a way that

- the arrangement of at least one of the groups and/or
- at least one overall arrangement of headlight element outputs of multiple groups

corresponds essentially to a desired emission characteristic of the headlight, in that, in particular, it has a shape which corresponds essentially to the cross-sectional shape of a desired headlight beam, wherein the semiconductor chips which belong to the headlight element outputs of one group can each be operated independently of other semiconductor chips.

2. The headlight as claimed in claim 1,

characterized in that

a beam angle of a light beam which is emitted from the

light output of the primary optics element is between 0 and 60°, preferably between 0 and 40°, particularly preferably between 0 and 20°, with the limits in each case being included.

3. The headlight as claimed in one of claims 1 and 2, characterized in that
at least parts of the headlight element outputs in at least one group are packed densely, and are preferably arranged without any gaps.

4. The headlight as claimed in one of claims 1 to 3, characterized in that
the semiconductor chips and/or the headlight element outputs are at least partially or at least in subgroups arranged like a matrix.

5. The headlight as claimed in one of claims 1 to 4, characterized in that
the headlight is intended for use in a motor vehicle, and in that the arrangement of at least one first group of headlight element outputs and/or of multiple first groups together corresponds essentially to an emission characteristic of a lower beam headlamp, in that, in particular, it corresponds essentially to the cross-sectional shape of a light beam of a lower beam headlamp, and in that at least one second group and/or multiple second groups is or are arranged together in such a way that, together with the arrangement of the first group or of multiple first groups it or they correspond together or on its or their own essentially to the emission characteristic of a upper beam headlamp, in that it corresponds in particular essentially to the cross-sectional shape of a light beam of a upper beam headlamp.

6. The headlight as claimed in claim 5,
characterized in that

the headlight has multiple first and second groups, wherein only semiconductor chips in some of the groups are in each case operated as a function of the steering angle of the motor vehicle when using the headlight elements in the first and/or the second groups, in such a way that the light beam which is emitted from the headlight at least partially follows the direction of travel of the motor vehicle.

7. The headlight as claimed in one of claims 1 to 6, characterized in that
the light output from the corresponding primary optics element is in each case the headlight element output.

8. The headlight as claimed in one of claims 1 to 7, characterized in that
each primary optics element is followed by an optical waveguide, preferably a glass fiber or a bundle with multiple glass fibers, with a light input surface and a light output surface, in the emission direction of the primary optics, into which at least the majority of the light which is emitted from the light output of the respective primary optics element is passed through the light input surface.

9. The headlight as claimed in claim 8 and referring back to one of claims 1 to 6,
characterized in that
the light output surface of the optical waveguide is in each case the headlight element output.

10. The headlight as claimed in one of claims 8 and 9, characterized in that
the light input surface of each of the optical waveguides is directly adjacent to the light output of the corresponding primary optics element.

11. The headlight as claimed in one of claims 8 to 10,

characterized in that
the optical waveguide is in each case connected by means of a connecting plug to the corresponding primary optics element, and/or in that the optical waveguide is in each case fitted with the light input surface, by means of an adhesive, to the light output of the corresponding primary optics element, and is connected to the primary optics element.

12. The headlight as claimed in one of claims 8 to 11, characterized in that
the optical waveguide is in each case connected by means of a connecting plug to the corresponding primary optics element, and in that the multitude of connecting plugs are connected to one another, or are formed integrally.

13. The headlight as claimed in one of claims 8 to 12, characterized in that
the optical waveguide is in each case connected by means of a connecting plug to the corresponding primary optics element, and in that the connecting plug is formed integrally with the primary optics element.

14. The headlight as claimed in one of claims 8 to 13, characterized in that
the optical waveguide is formed integrally with the corresponding primary optics element.

15. The headlight as claimed in one of claims 1 to 14, characterized in that
the light input has a light input surface or a light input opening, whose size is less than or equal to twice the chip output area, and is preferably less than or equal to 1.5 times the chip output area.

16. The headlight as claimed in one of claims 1 to 15, characterized in that

the primary optics element is in each case an optical concentrator, with the light input being the actual concentrator output, so that light passes through this in the opposite direction compared with the normal use of a concentrator for focusing, and is thus not concentrated, but leaves the concentrator through the light output with reduced divergence.

17. The headlight as claimed in claim 16, characterized in that the primary optics element is a CPC, CEC or CHC-like concentrator.

18. The headlight as claimed in claim 16, characterized in that the concentrator has side walls which connect the light input to the light output and are designed in such a way that direct connecting lines which run on the side walls run essentially in a straight line between the light input and the light output.

19. The headlight as claimed in one of claims 16 to 18, characterized in that the concentrator has a cross-sectional surface in the form of a regular polygon, preferably a square cross-sectional surface, in a region on the side of the light input, and in that it likewise has a cross-sectional surface in the form of a regular polygon, preferably a triangular, quadrilateral, hexagonal or octagonal cross-sectional surface, in a region on the side of the light output.

20. The headlight as claimed in claim 16 or 19, characterized in that the concentrator has a base body which defines a cavity, whose internal wall is reflective for the light emitted from the semiconductor chip and/or whose

internal wall is essentially provided with a layer or layer sequence, preferably with a metallic layer, which is reflective for the light emitted from the semiconductor chip.

21. The headlight as claimed in one of claims 16 to 19,
characterized in that
the concentrator is a dielectric concentrator, whose base body is a solid body which is composed of a dielectric material with a suitable refractive index such that light which is injected via the light input is reflected in this by total internal reflection on the side boundary surface of the solid body, which connects the light input to the light output, to the external atmosphere.

22. The headlight as claimed in claim 21,
characterized in that
the light output is a boundary surface of the solid body that is curved like a lens.

23. The headlight as claimed in claim 22,
characterized in that
the light output is curved in the form of an aspherical lens.

24. The headlight as claimed in one of claims 16 to 23,
characterized in that
the dielectric concentrator is provided at least partly with a layer or layer sequence, preferably with a metallic layer, which is reflective for the light which is emitted from the respective semiconductor chip.

25. The headlight as claimed in one of claims 16 to 24,
characterized in that

the concentrator is arranged downstream from the semiconductor chip in its main emission direction, and in that there is a gap between the chip output surface and the light input of the concentrator.

26. The headlight as claimed in claim 25,
characterized in that
the gap is substantially free of solid or viscous materials.

27. The headlight as claimed in claim 25 or 26,
characterized in that
the headlight element has one or more reflector elements which are arranged in such a way, and/or are of such a shape that some of the light beams which do not pass directly from the semiconductor chip into the concentrator are reflected multiple times on it and are deflected at a smaller angle, measured against the main emission direction of the semiconductor chip, to the light input of the concentrator.

28. The headlight as claimed in one of claims 19 to 27,
characterized in that
the base body of the concentrator is composed of a transparent glass, a transparent crystal or a transparent plastic, and in that it is preferably manufactured using an injection-molding and/or transfer-molding process.

29. The headlight as claimed in one of claims 1 to 28,
characterized in that
the semiconductor chip is a diode which emits electromagnetic radiation, preferably a diode which emits electromagnetic radiation and has an at least approximately Lambert emission characteristic, particular preferably being a thin-film light-emitting diode.

30. The headlight as claimed in claim 29, characterized in that the diode is followed in the emission direction by a luminescence conversion material, which converts the wavelength of at least a portion of the electromagnetic radiation emitted from it.

31. The headlight as claimed in one of claims 1 to 30, characterized in that the headlight elements are followed in their main emission direction by secondary optics, by means of which the light emitted from them experiences a further reduction in divergence, and/or is mixed.

32. The headlight as claimed in claim 31, characterized in that the secondary optics are a condensor lens.

33. The headlight as claimed in one of claims 1 to 32, characterized in that the primary optics elements of multiple headlight elements are formed integrally with one another.

34. The headlight as claimed in one of claims 1 to 33, characterized in that the semiconductor chips are arranged on in each case one mount, on which they are in each case surrounded by a frame to or in which the primary optics element is fitted and by which it is held, and/or by which it is adjusted relative to the chip output surface.

35. The headlight as claimed in claim 34, characterized in that at least some of the mounts and/or the mount and the frame in each case are formed integrally.

36. The headlight as claimed in one of claims 34 and

35,
characterized in that
the mounts of multiple semiconductor diodes are arranged alongside one another, like rows, in at least one row.

37. The headlight as claimed in one of claims 34 to 36,
characterized in that
the internal surface of the frame and/or free surfaces of that surface of the mount which faces the emission direction of the headlight

- is or are reflective for light which is emitted from the respective semiconductor chip, and/or
- is or are at least partially provided with a layer or a layer sequence, preferably with a metallic layer, which is reflective for the light which is emitted from the respective semiconductor chip.

38. A headlight element having

- at least one semiconductor chip which emits electromagnetic radiation and has a chip output surface through which electromagnetic radiation is emitted,
- a primary optics element, which has a light input and a light output and which reduces the divergence of the light which is incident through the light input, with the light being at least a part of the electromagnetic radiation and/or at least a part of a secondary radiation which is produced from the electromagnetic radiation,

and

- at least one headlight element output, from which a part of the headlight light is emitted from the headlight element,

characterized in that
the primary optics element is in each case a CPC, CEC or CHC-like optical concentrator, with the light input

being the actual concentrator output, so that light passes through this in the opposite direction compared with the normal use of a concentrator for focusing, and is thus not concentrated, but leaves the concentrator through the light output with reduced divergence.

39. The headlight element as claimed in claim 38, characterized in that
the concentrator has a cross-sectional surface in the form of a regular polygon, preferably a square cross-sectional surface, in a region on the side of the light input, and in that it likewise has a cross-sectional surface in the form of a regular polygon, preferably a triangular, quadrilateral, hexagonal or octagonal cross-sectional surface, in a region on the side of the light output.

40. The headlight element as claimed in one of claims 38 and 39,
characterized in that
the concentrator has a base body which defines a cavity, whose internal wall is reflective for the light emitted from the semiconductor chip and/or whose internal wall is essentially provided with a layer or layer sequence, preferably with a metallic layer, which is reflective for the light emitted from the semiconductor chip.

41. The headlight element as claimed in one of claims 38 and 39,
characterized in that
the concentrator is a dielectric concentrator, whose base body is a solid body which is composed of a dielectric material with a suitable refractive index such that light which is injected via the light input is reflected in this by total internal reflection on the side boundary surface of the solid body, which connects the light input to the light output, to the

external atmosphere.

42. The headlight element as claimed in claim 41, characterized in that the dielectric concentrator is provided at least partly with a layer or layer sequence, preferably with a metallic layer, which is reflective for the light which is emitted from the respective semiconductor chip.

43. The headlight element as claimed in one of claims 38 to 42, characterized in that the concentrator is arranged downstream from the semiconductor chip in its main emission direction, and in that there is a gap between the chip output surface and the light input of the concentrator.

44. The headlight element as claimed in claim 43, characterized in that the gap is substantially free of solid or viscous materials.

45. The headlight element as claimed in one of claims 43 and 44, characterized in that the headlight element has one or more reflector elements which are arranged in such a way, and/or are of such a shape that the majority of the light beams which do not pass directly from the semiconductor chip into the concentrator are reflected multiple times on it and are deflected at a smaller angle, measured against the main emission direction of the semiconductor chip, to the light input of the concentrator.

46. The headlight element as claimed in one of claims 38 to 45, characterized in that

the base body of the concentrator is composed of a transparent glass, a transparent crystal or a transparent plastic, and in that it is preferably manufactured using an injection-molding and/or transfer-molding process.

47. The headlight element as claimed in one of claims 38 to 46,
characterized in that
the light output of the concentrator is the headlight element output.

48. The headlight element as claimed in one of claims 38 to 47,
characterized in that
the concentrator is followed by an optical waveguide, preferably a glass fiber or a bundle with multiple glass fibers, with a light input surface and a light output surface, in the emission direction of the primary optics, into which at least the majority of the light which is emitted from the light output of the concentrator is passed through the light input surface.

49. The headlight element as claimed in claim 48 and referring back to one of claims 38 to 46,
characterized in that
the light output surface of the optical waveguide is the headlight element output.

50. The headlight element as claimed in one of claims 48 and 49,
characterized in that
the optical waveguide is formed integrally with the corresponding concentrator.